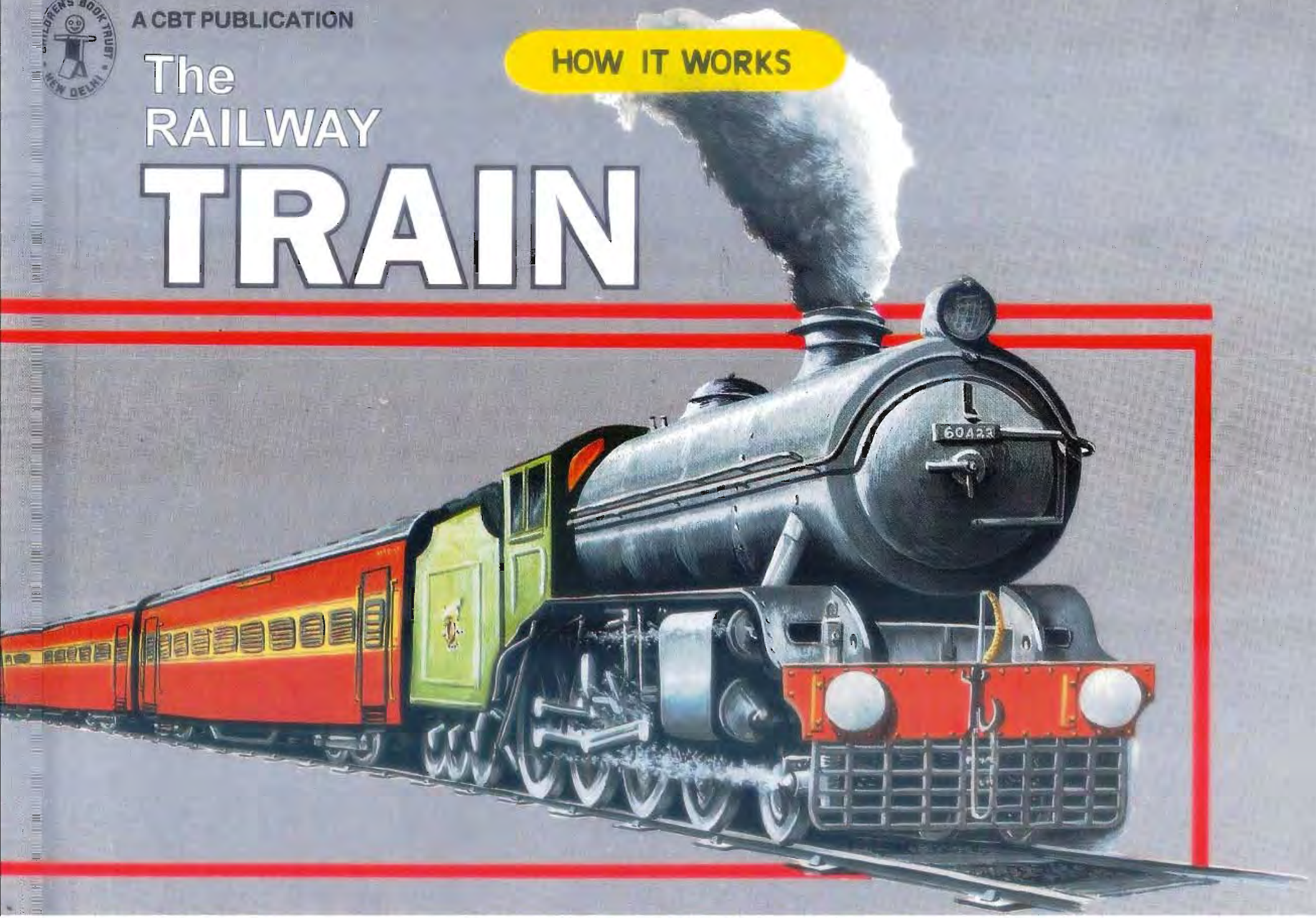




A CBT PUBLICATION

The RAILWAY TRAIN

HOW IT WORKS



The RAILWAY TRAIN

HOW IT WORKS

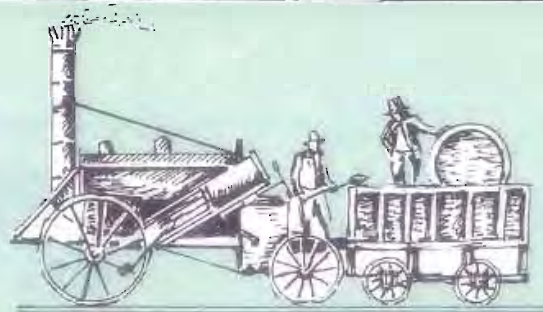


Children's Book Trust, New Delhi

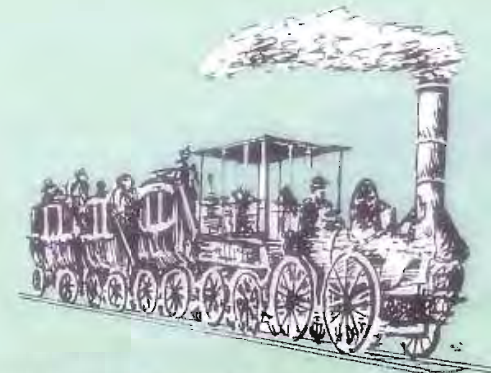
BY NAVKALA ROY
ILLUSTRATED BY T. KARTHIKEYAN



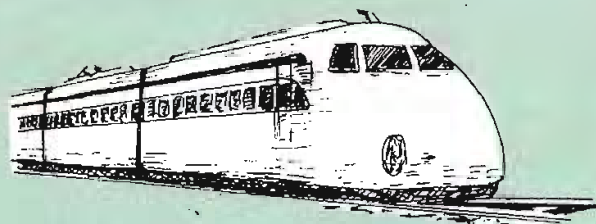
Horse-drawn carriage



Locomotion

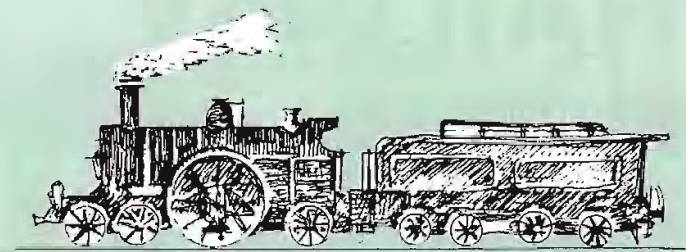


Open railway carriage

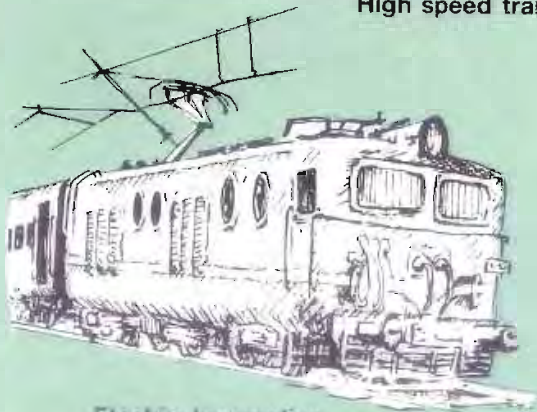


High speed train

JOURNEY THROUGH THE AGES



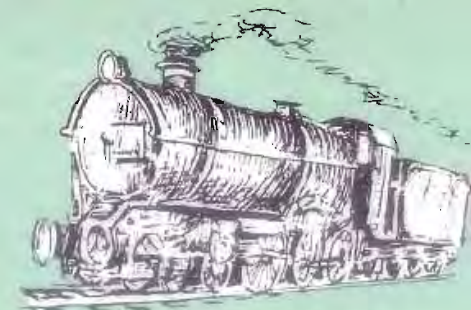
Early steam engine



Electric locomotive



Diesel-electric locomotive



Steam locomotive



“Fish and chips...fish and chips...fish and chips...” Say that fast; then try saying it faster and faster and faster still! And what do you hear? A lovely, long beautiful train chugging merrily, over the mountains and over the plains. “Fish and chips...fish and chips...fish and chips...Soooooooooooooooooup!”

Wheel after wheel after wheel rolling thousands of kilometres of track—cutting

through the hills or speeding along the forests, crossing wide rivers or braving dusty deserts has stirred a spirit of adventure in all of us. How often you all must have lined up, one behind the other, and fancied yourselves as an express train pulling out of the station!

Now, if you knew how many trains actually

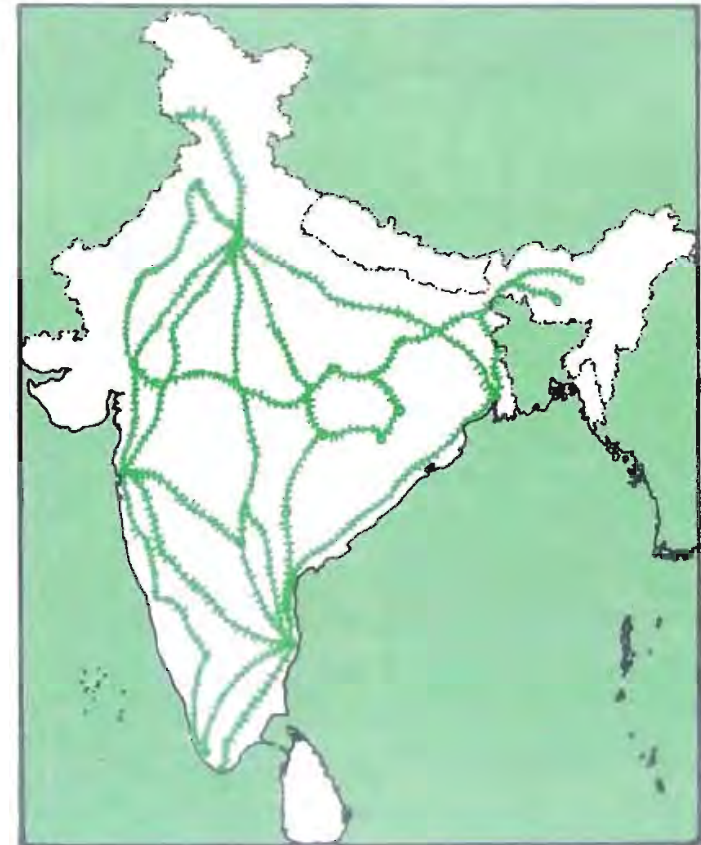
pull out of different stations in India each day, or, how far they travel, how much load they can take on, you would probably suffer a mild heart attack!

The Indian Railways (hold your breath!) carry over eleven million passengers every day. That is almost the entire population of Australia! And one million tonnes of freight every day. It has a network of 62,725 kilometres of track, linking 6,896 stations and across 1,21,699 bridges. And yes, it covers each day three and half times the distance to the moon.

The Indian Railways run about 12,000 trains every day. The Ninth Five Year Plan, 1997–2002, has an outlay of Rs. 45,413 crores for the Indian Railways.

By almost any stretch of imagination, it is a staggering operation. Our trains move more people than any other transport system anywhere. No wonder then, the Indian Railways are known as the Iron Ganga of India.

And like the historic river, the coming of the railways changed the course of many lives in India.



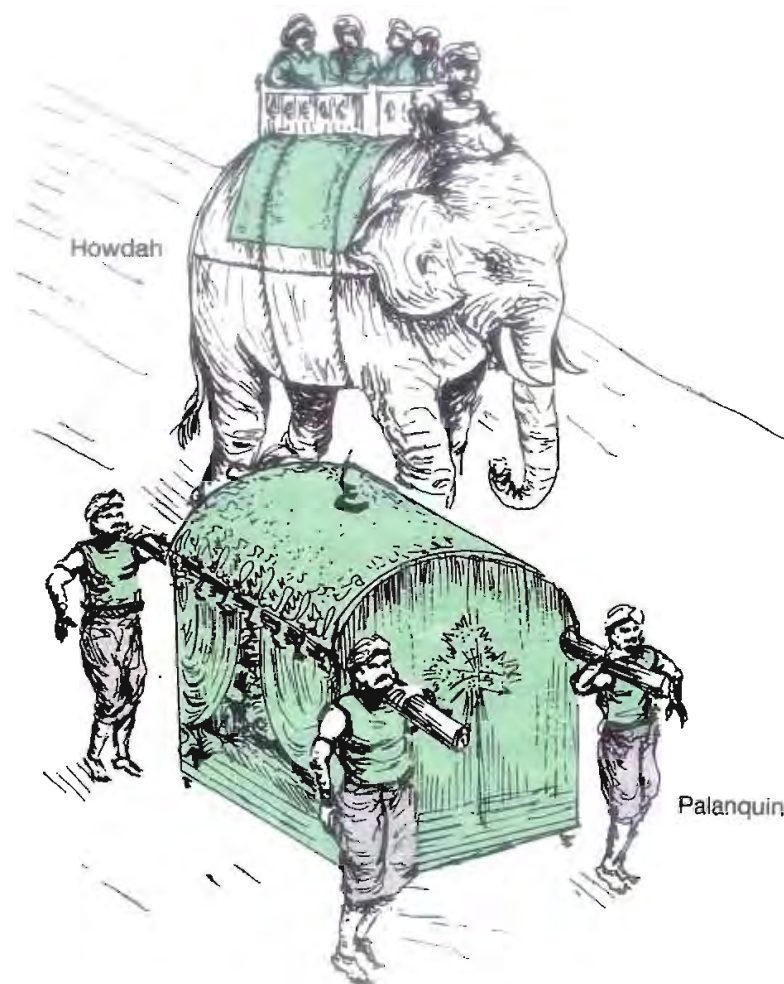
Railway lines, more and more...

The weary traveller

Travel, in the opening years of the nineteenth century, was a very tedious and slow process, the world over. There was, generally speaking, hardly any movement of people from one place to another. Pilgrim centres, of course, attracted vast crowds, especially Varanasi, Haridwar, Rameswaram and so on. But so uncertain was the return of a pilgrim that many hesitated to step out of their homes. Travellers often fell ill and died. Others suffered the risks of being waylaid. For, travelling those days meant going mostly on foot or bullock carts, if and when available.

Horses were not commonly used in India, as they were costly. In Rajasthan, Gujarat and Sindh camels were in great abundance and were, therefore, used for towing caravans. It took 35 to 40 days, however, travelling from Surat to Agra in a caravan.

Palanquins were used in cities and for long journeys. They were usually carried by four



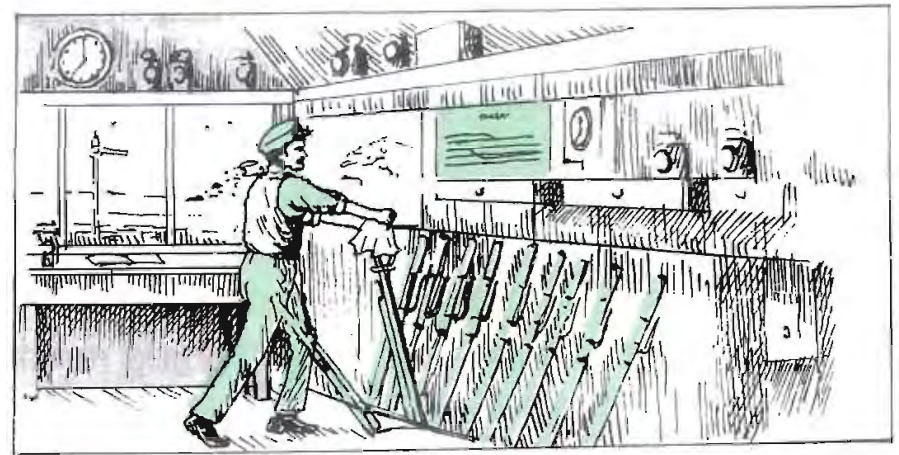
men, though eight or twelve people were engaged for relieving one another. Elephants with howdahs were also used.

Rivers, mostly unbridged, could be crossed only during the dry seasons. In utter despair an English merchant remarked—"Of what earthly use is the cotton produced by Broach, if this cannot be shifted to Bombay quickly enough and without any damage on the way?"

Out of despair, they say, comes hope. That, perhaps, is what egged man on to progress. Narrow paths gradually changed into roads and wheeled carts increased in number. They were used for carrying goods from the countryside to towns and ports.

The really momentous change, however, came with the invention of the railway. And almost simultaneously human civilization took a leap ahead. Not only did mass movement of people become easier, but mountains of material could now be transported from one part of the country to another. A railway line passing through a remote area suddenly brought it on the road to big towns, cities and ports. Besides this, the construction of

railways itself soon became a major industry. Steel plants and thermal powerhouses sprang up as a result and became the key industries of the first half of the twentieth century.



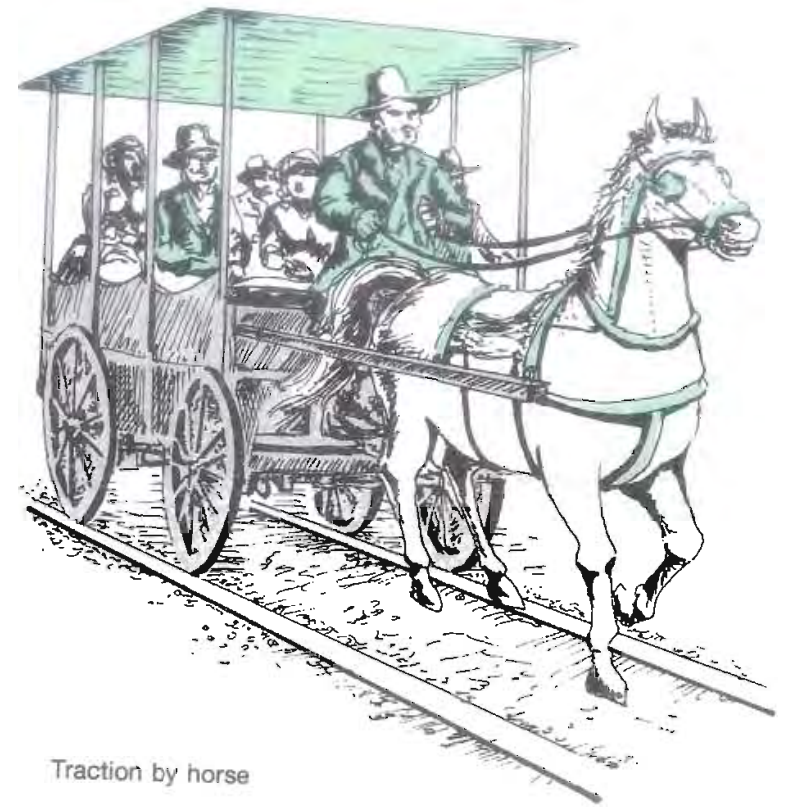
Signal levers

If you have stood near a busy railway crossing, you may have heard different bells ringing and wondered what all the fuss was about! Well, these bells are actually codes that some signalmen use even today, to advise each other about the trains going through. They not only warn the signalman to expect a train but they tell him what kind of train it is.

When the trains went clip-clop

Fancy a horse with a long train behind it, going...clip-clop clippety-clop down a railway track! Well, that is exactly how the first trains worked. Except that they were known as wagons.

When it was discovered that heavy loads could be carried along a smooth track more easily than on a rough road, some coal miners got together and laid wooden rails. On these they placed wagons carrying coal. But a push was not enough to keep the wagons going. So horses were brought in. And it was 'clip-clop clip-clop' all the way, though considerably faster than before. But wooden rails were not very strong. So the rails and wheels of the trucks (wagons) were made of iron instead.



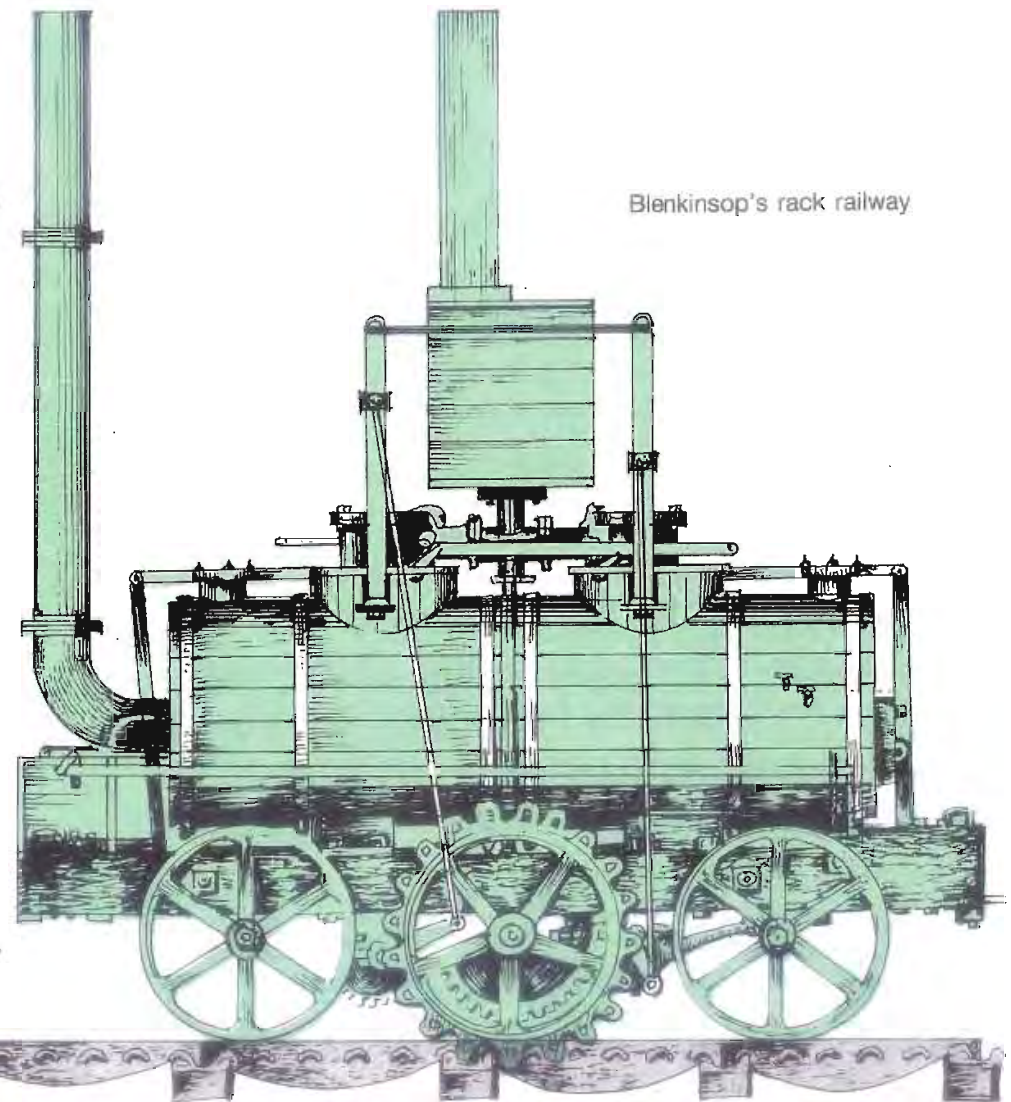
Traction by horse

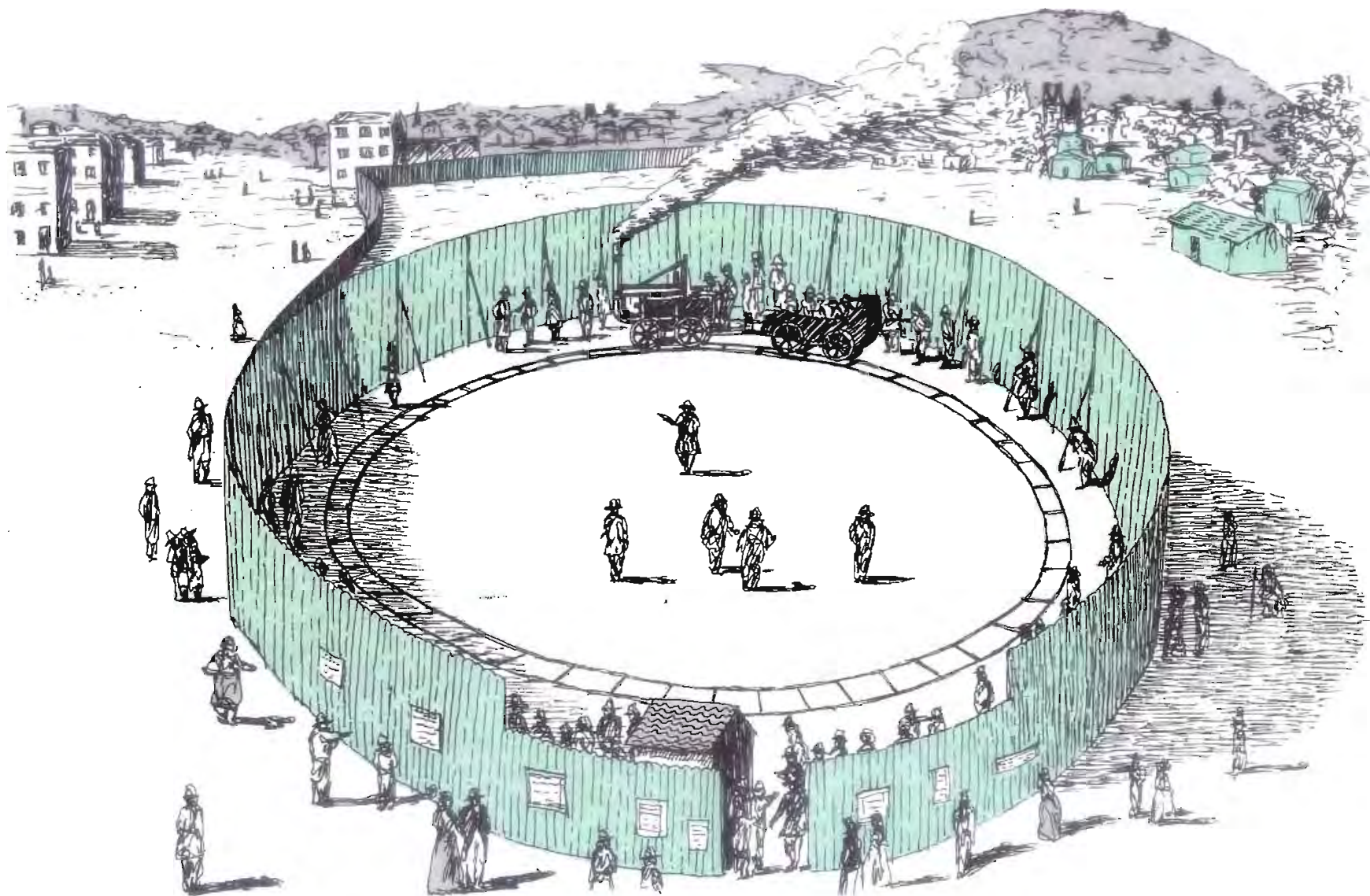


World's first train

Trains, as we know them today, came into existence much later. In 1812, a mine inspector, John Blenkinsop, designed a rack railway. This meant that the rails had teeth which engaged with toothed wheels on the wagons. For, Blenkinsop believed that smooth wheels would slip on rails. Blenkinsop's system was the forerunner of mountain rack railways the world over, including the lovely hill trains we have today, going up to Shimla, Ootacamund or Darjeeling. Toothed tracks are very much in use along these routes and worth a visit if you haven't seen them already.

However, the first steam engine to run on rails was built by Richard Trevithick called 'Catch me who can'. This resembled a toy train with a circular track and thus the name.





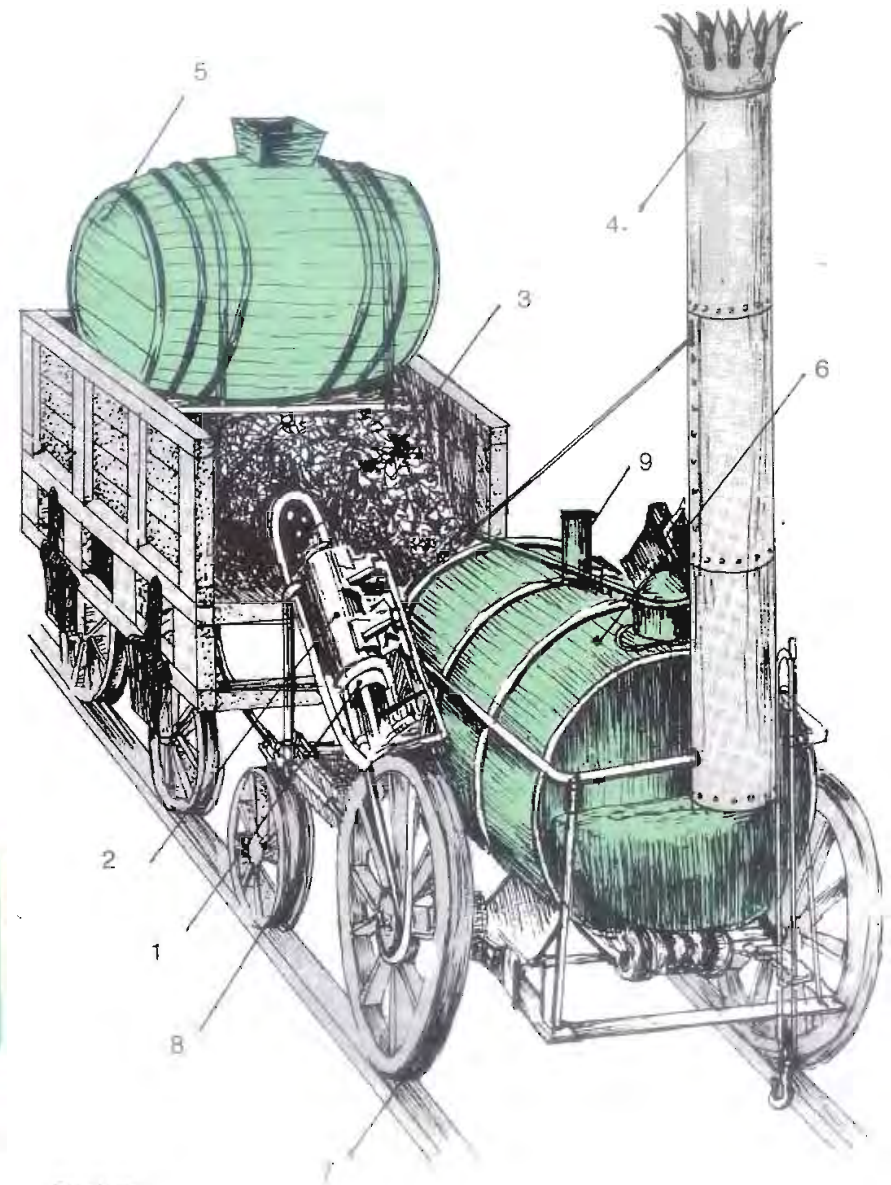
Catch me who can — Richard Trevithick's demonstration of a railroad

It was in 1823, when an Englishman, George Stephenson, was appointed as engineer to the Stockton and Darlington Railway that the turning point in railway history came. Stephenson dreamt of a land criss-crossed by a network of steam railways. He set about his task diligently and in 1825, when a 40-kilometre line was opened in County Durham, Stephenson and his son Robert made history by inaugurating the world's first public steam railway, called 'Locomotion'. It could haul freight about 19 to 25 kilometres an hour.



The oldest station in the world is Liverpool Road Station, in England. It was first used on September 15, 1830, and is now partly turned into a museum.

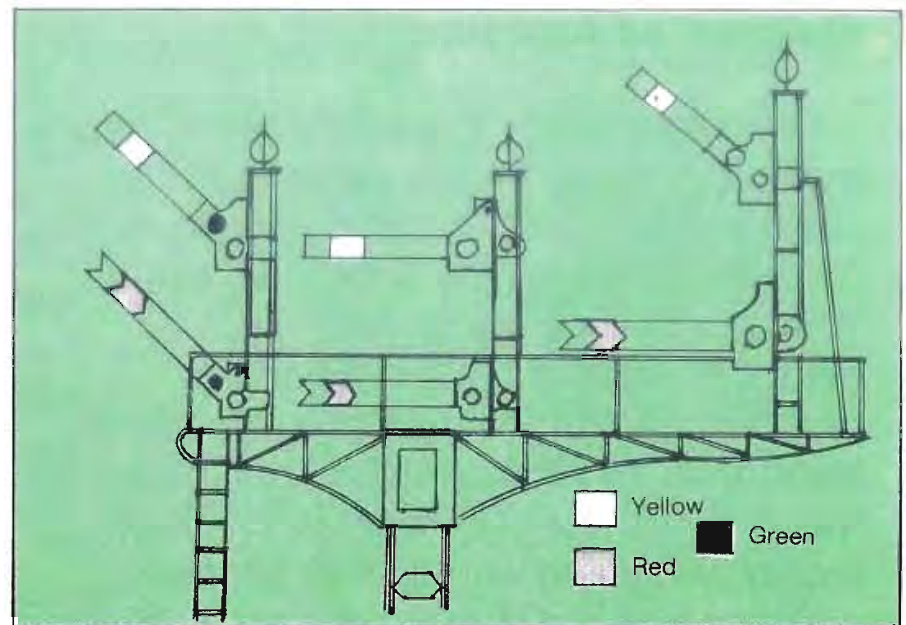
1. Piston 2. Cylinder 3. Coal supply 4. Chimney 5. Water barrel
6. Boiler 7. Driving wheel 8. Trailing wheel 9. Safety valve



Rocket

Inspired by their success, the Stephensons introduced yet another engine, the 'Rocket' in 1829. This was when the Liverpool and Manchester Railways were holding trials to locate the best engine available. The 'Rocket' had a new design. It had a boiler in which the water was turned into steam by contact with 25 tubes which were heated from a fire-box. This, along with an improved exhaust system, enabled the 'Rocket' to pull a 14-ton train at almost 46 kilometres per hour.

The 'Rocket' in fact was the beginning of the passenger train—speedier, more comfortable and cheaper than horse-drawn services. Have you ever imagined yourself sitting in a train without a roof over your head! Well, the first railway carriages for people were open and smoke from the engine blew in their faces. In its very first year it carried more than 70,000 persons and 40,000 tonnes of freight. It was a major engineering feat!



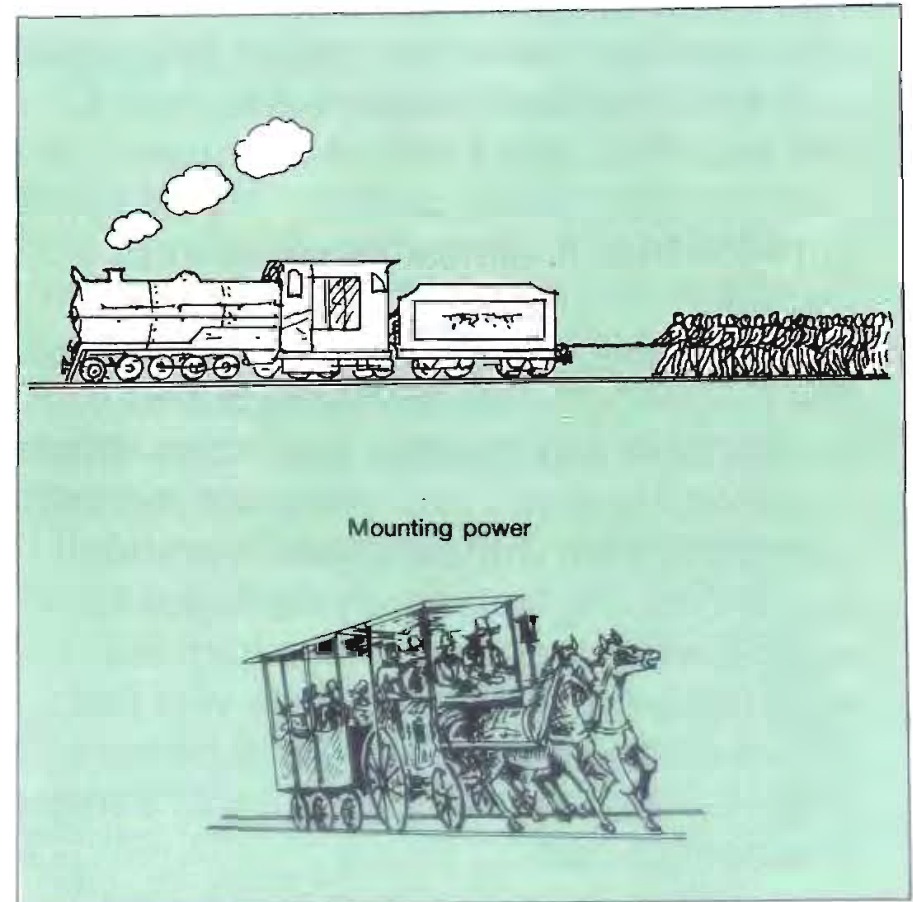
Signals are a very important part of train journeys. In order to attract the driver's attention, they are painted red or yellow arms on tall white posts. If these arms hang down or incline upwards, it means the line is clear ahead. But if one of the red signal arms stands at right angles to the signal post, it means "danger" and the driver must stop at once. Yellow arms in the horizontal position is a warning to the driver to slow down. Green light stands for "all clear".

'Delirium ad furiosum'

Overwhelmed by this totally revolutionary method of travel, people came out with strange predictions about its consequences. 'The smoke will kill the birds,' said some. 'The cows will cease to give milk,' said others. A panel of London scientists pronounced that the train should never go faster than 48 kilometres an hour, otherwise "passengers would suffocate". The medical faculty at Munich warned that all railway passengers were sure to contract a new type of mental illness called 'Delirium ad furiosum'.

The phenomenal success of the railways drowned all such forecasts. Not only did communication become easier but also more economical. It gave England, the innovator of railways, the power and wealth to dominate much of the world. It was as if England had acquired, all of a sudden, an army of millions of inanimate slaves to sweat and toil for her, without her having to feed or clothe them.

One steam engine of 500 horsepower (1hp=750 watts) is equivalent to a force of about 10,000 men. The work of a million men can be done with 100 steam engines.



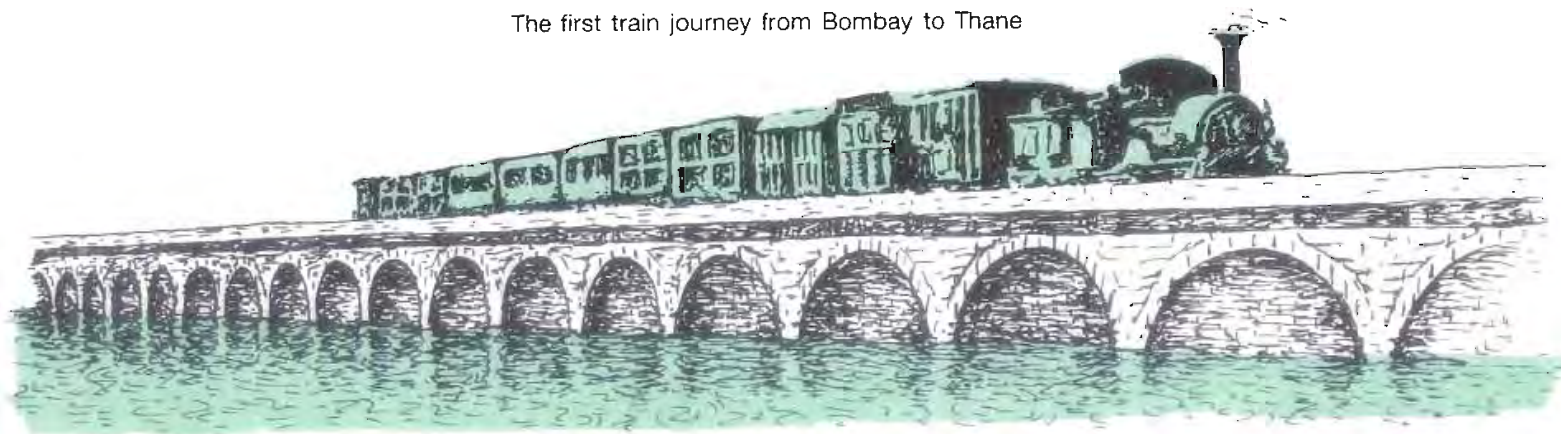
Bombay to Thane

Just 25 years after the world's first train had made its successful run in England, railways had come to India. The very first locomotive to run in India was in December 1851 near Roorkee, an engine named 'Thomson' which was used to build the Ganga canal. However, it was on April 16, 1853, when the inaugural train ran between Bombay and Thane, a stretch of 21 miles (approximately 35 kilometres). This was the first railway line built in India by the Great Peninsular Railway Company.

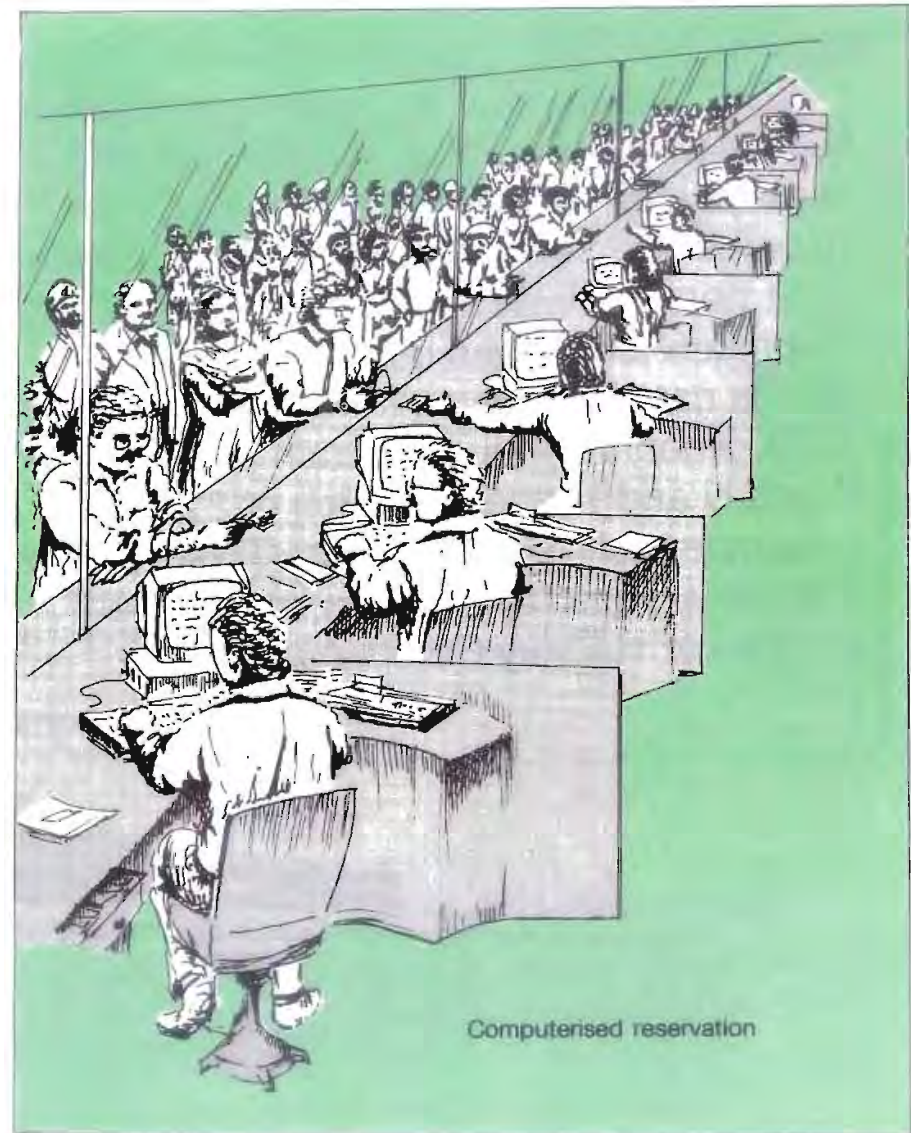
The first train with fourteen railway carriages carrying 400 guests left Boribunder at 3.30 p.m. "amidst loud applause of a vast multitude and to the salute of 21 guns"! They reached Thane at about 4.45 p.m. Refreshments were served and the new company was felicitated. The guests returned to Bombay at 7.00 p.m.

The next day Sir Jamshedji Jeejeebhai, a baronet, reserved the entire train and travelled from Bombay to Thane and back with some members of his family.

The first train journey from Bombay to Thane



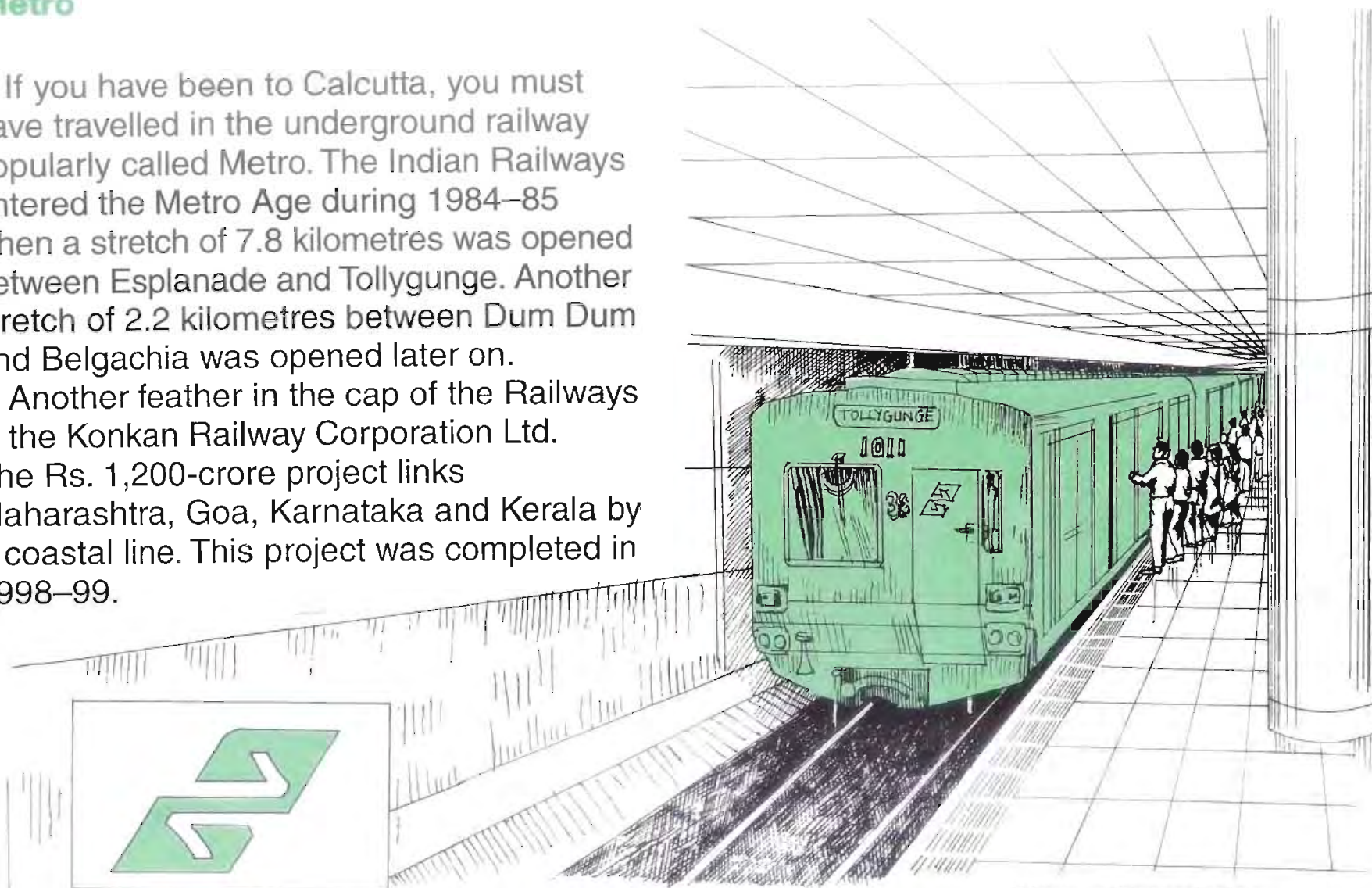
In stages this railway line was extended to Delhi. Another was built from Howrah to Hugli. There were 3,000 applications from those who wanted to ride in the first train that was to steam out of Howrah on August 15, 1854. The lucky ones got first class tickets for Rs. 3.00! The fare for the third class was seven annas (or 42 paise)! In 140 years if the railway fares have gone up by as many number of times, and the traffic load by over 180 per cent, likewise, the Indian Railways have also grown into the second largest railway network in the world and the largest civilian organization under a single management. Passengers can travel in air-conditioned comfort (first or second class). Computerised Reservation System has opened a new chapter in the history of public service. At present the Indian Railways carry 4,368 million passengers and 429.3 million tonnes of freight traffic. Now you know why a separate Railway Budget is announced by the Minister concerned every year.



Metro

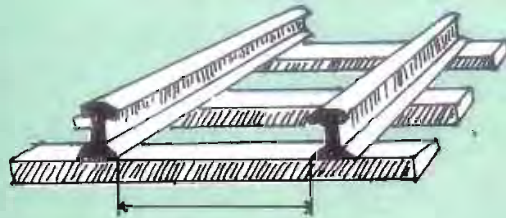
If you have been to Calcutta, you must have travelled in the underground railway popularly called Metro. The Indian Railways entered the Metro Age during 1984–85 when a stretch of 7.8 kilometres was opened between Esplanade and Tollygunge. Another stretch of 2.2 kilometres between Dum Dum and Belgachia was opened later on.

Another feather in the cap of the Railways is the Konkan Railway Corporation Ltd. The Rs. 1,200-crore project links Maharashtra, Goa, Karnataka and Kerala by a coastal line. This project was completed in 1998–99.

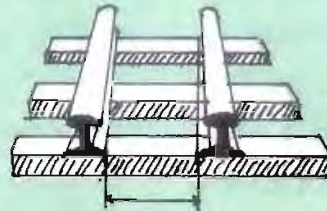


Metro—underground railway

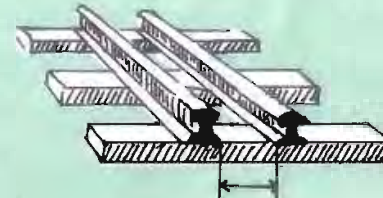
The three different widths of tracks



Broad gauge

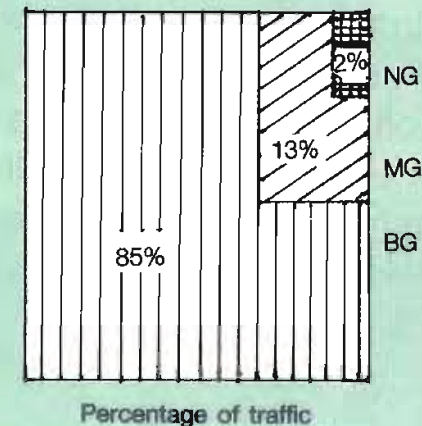


Metre gauge



Narrow gauge

The Indian Railways operate on three gauges—broad gauge, metre gauge and narrow gauge. Today most of the trains run on broad gauge (measurement between the tracks being 1.68 metres or 5 feet 6 inches), be it they carry cargo or passengers. Metre gauge (which is simply a metre wide, that is, approximately 3 feet 3 inches) trains can be seen connecting small places but not on a trunk route. And narrow gauge (which measures 2 feet 2 inches) trains run in the hilly areas like Darjeeling, Ooty, Shimla.

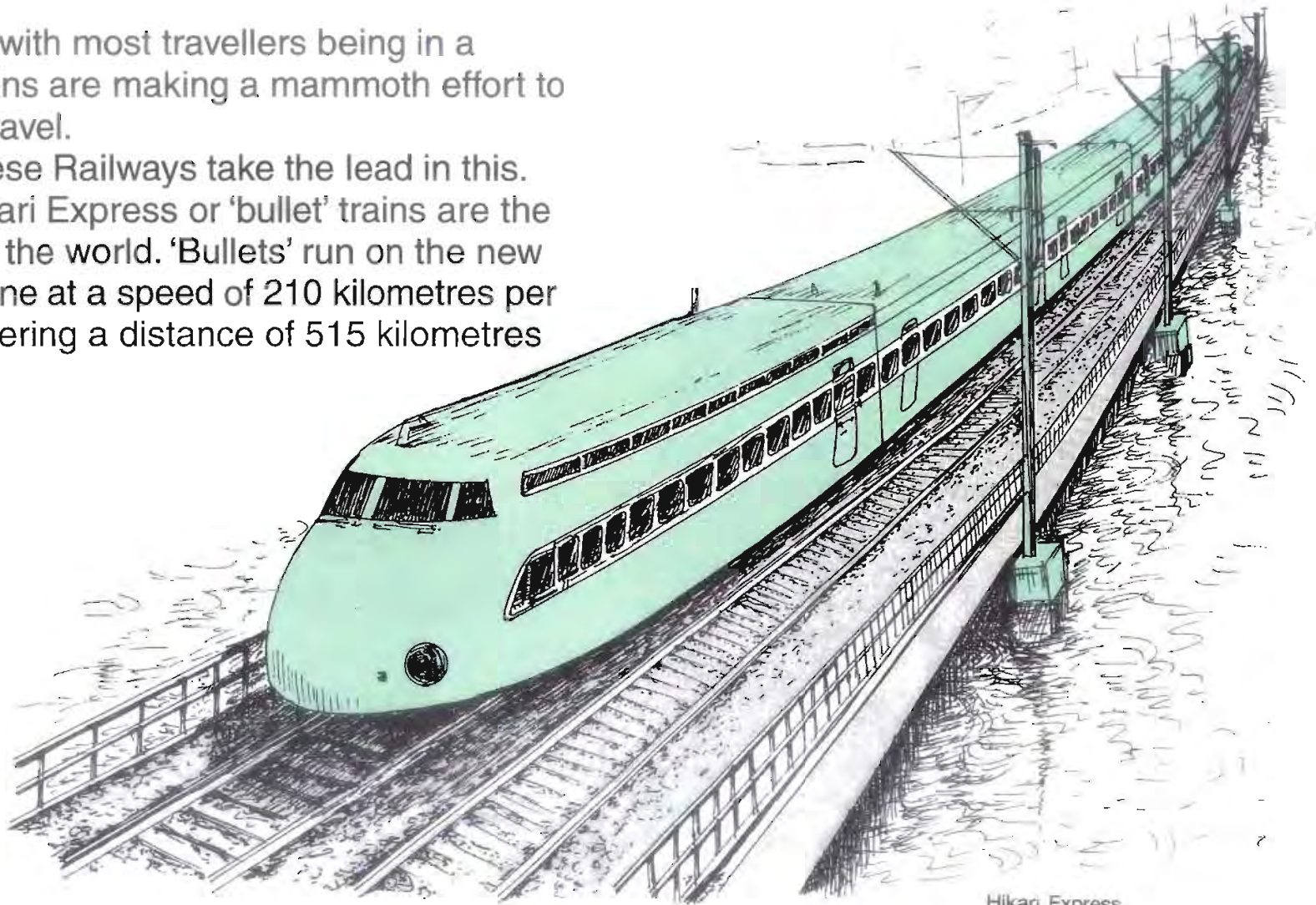


The longest platform in the world is the Kharagpur platform in India. It measures 833 metres (2,733 feet) in length.

Aerotrains

Today, with most travellers being in a hurry, trains are making a mammoth effort to rival air travel.

Japanese Railways take the lead in this. Their Hikari Express or 'bullet' trains are the fastest in the world. 'Bullets' run on the new Tokaido line at a speed of 210 kilometres per hour, covering a distance of 515 kilometres

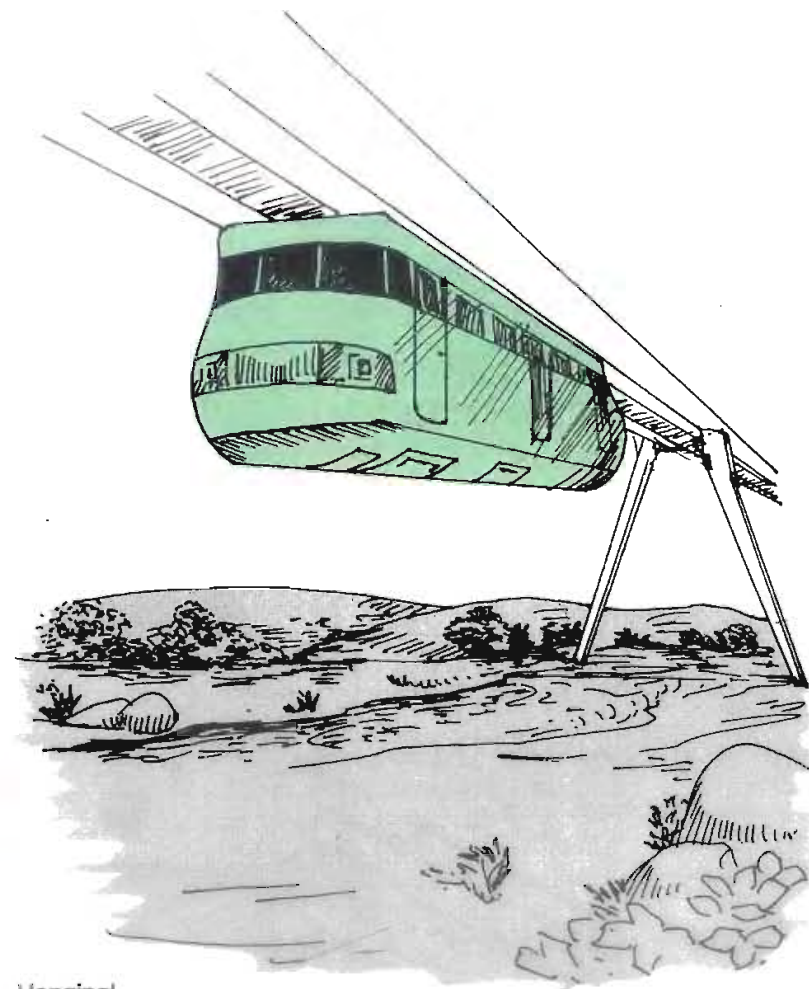


Hikari Express

between Tokyo and Osaka in just three hours and ten minutes. (A far cry from Stephenson's first endeavour!) These trains are not only fast but also clean, comfortable and pressurized, like an aeroplane. Some see the possibility of a 'flying' train in the not too distant future! In France, Jean Bertin's 'aerotrain' as it is called, 'flew' five millimetres (1/5 inch) above a concrete track. Air-cushion trains have been tried in Britain too, where the Hovercar system used a V-shaped groove instead of a rail.

However, getting down to 'brass tacks', let us see how the railway train, as we know it, works.

★ You must have seen pictures of a train hanging from an overhead track. Or perhaps you have travelled in one. Monorails, as these are called, do exist in Germany, Japan and the United States. However, they are expensive to build, complex and slow compared to conventional lines, and have not been widely adopted.

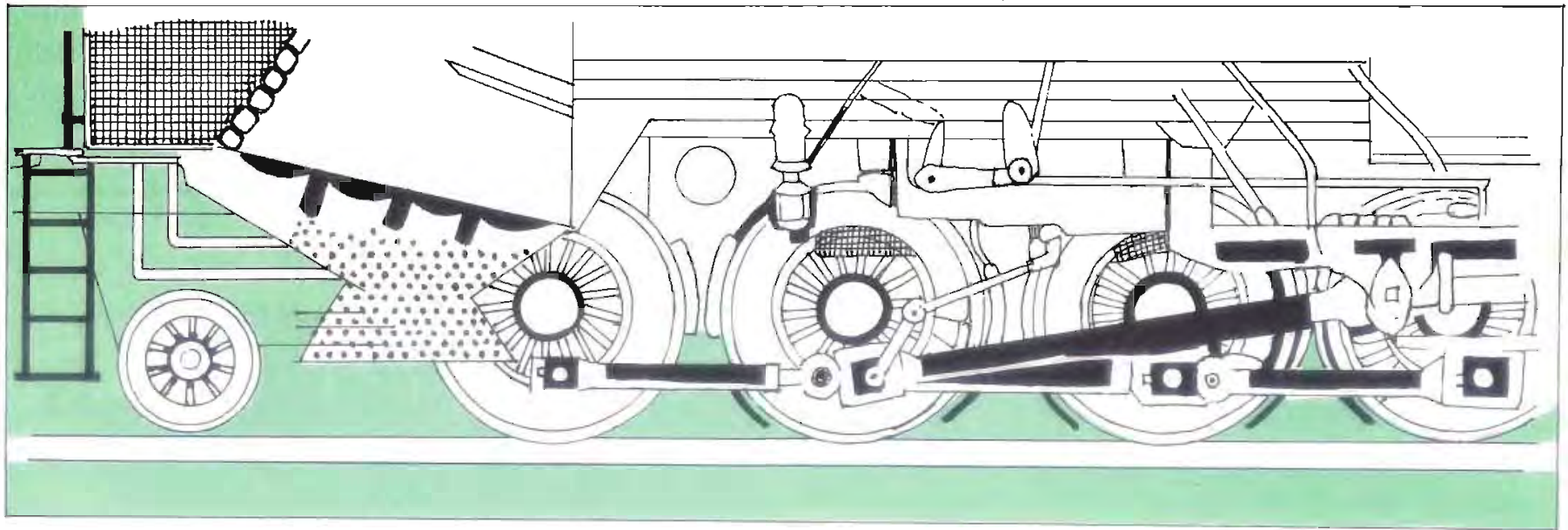


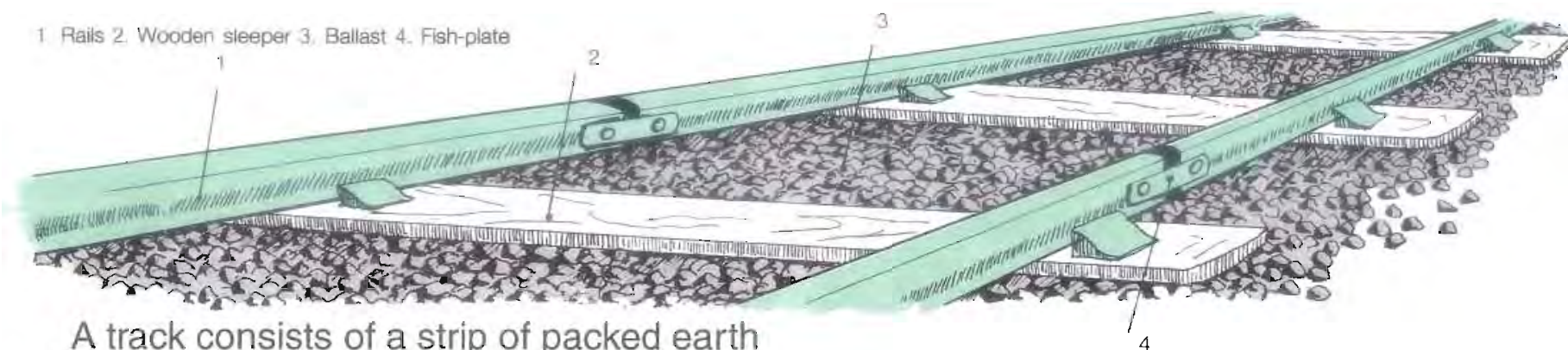
Hanging!

Tracks and wheels

Looking at a train, one would imagine that it is the simplest thing in the world to operate. All it appears to do is to get on to a smooth track and slide along merrily, singing fish and chips...fish and chips... (if it is driven by a steam engine) and breaking to a halt once in a while.

Well, a train certainly is easier to run than many other modern forms of transport. Unlike a car or a truck, the wheels of a train are guided by a track. If, for instance, a train were set rolling on a level track at 100 kilometres per hour, it would travel at least eight kilometres before coming to a stop. In contrast, a highway truck set rolling on a road at the same speed would travel only a kilometre and a half.





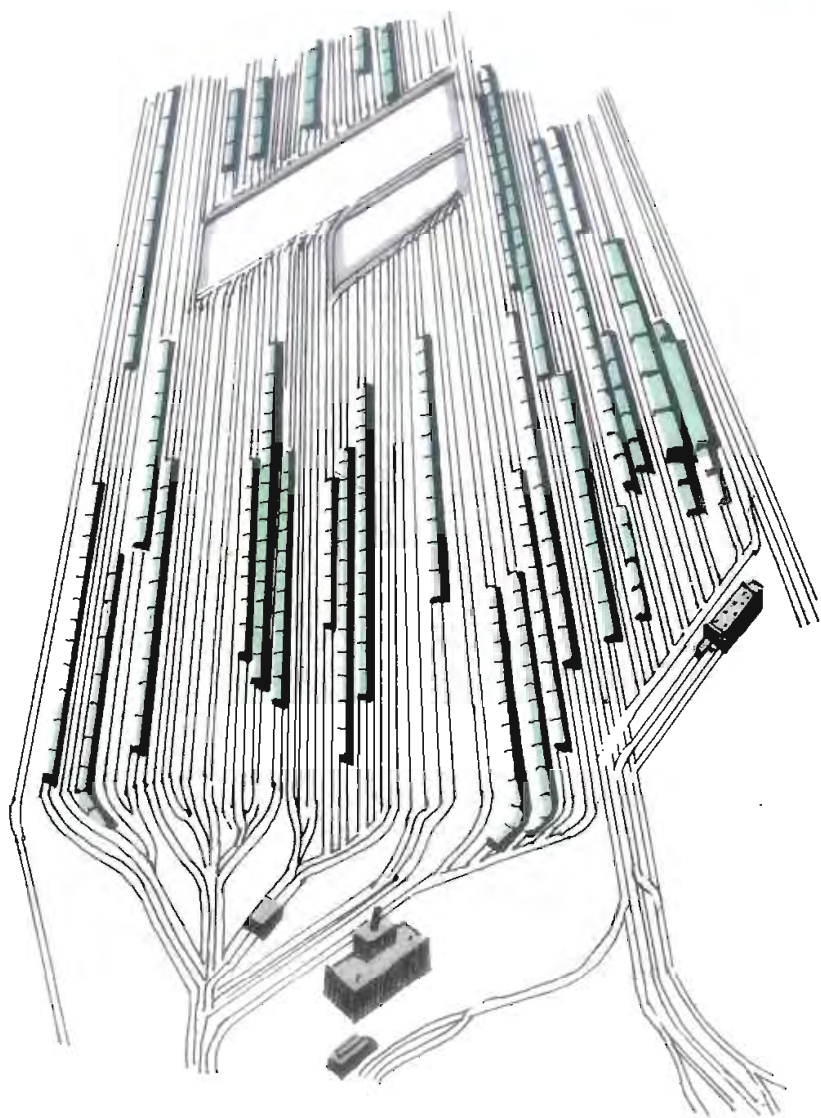
A track consists of a strip of packed earth covered with a layer of ballast (sand, gravel or coal ash), and the tracks are supported by sleepers.

Railway tracks are not always straight as they may appear to us when we travel in a train. Neither are they continuous. The short sections of tracks are joined by fish-plates (flat pieces of iron). When the wheels move on these joints they produce that very familiar and rhythmic sound of 'Clackety-clack'. Increasingly fish-plates are becoming obsolete these days; the rails are now welded together to form a continuous surface many miles long. Welded rails provide greater safety and comfort.



A British steam engine, Mallard, holds the world speed record for steam traction. In 1938, it travelled at 202 kilometres per hour.

Thanks to the tracks and the smooth rolling of its wheels, a train can move far more easily, pull much heavier loads while consuming much less energy than any other means of conveyance.



A marshalling yard—aerial view

However, operating a train is not as easy as it appears to be. Firstly, thousands of trains move along thousands of kilometres of track every day. And they do not all travel straight or on only one track or round and round (as we often imagine when we paint pictures!). Train departures and arrivals, therefore, have to be regulated. At times, tracks need to be changed along the way. Signals have to be obeyed and followed.

Hours before a train is flagged off, all its wagons or bogies, as we call them in India, are put together. This is done in a marshalling yard. The Mughal Sarai marshalling yard is the biggest of its kind in India.

At times a bogie needs to be changed from one track to another. This is called shunting.

What is it then that keeps a train going hour after hour and sometimes day after day, non-stop, pulling such enormous weight along with it?

Steaming off

The earliest railway engines were powered by steam. Yet, even today, steam engines are the most interesting engines to study.

Steam engines are not popular these days as most of the trains are run on diesel and electricity.

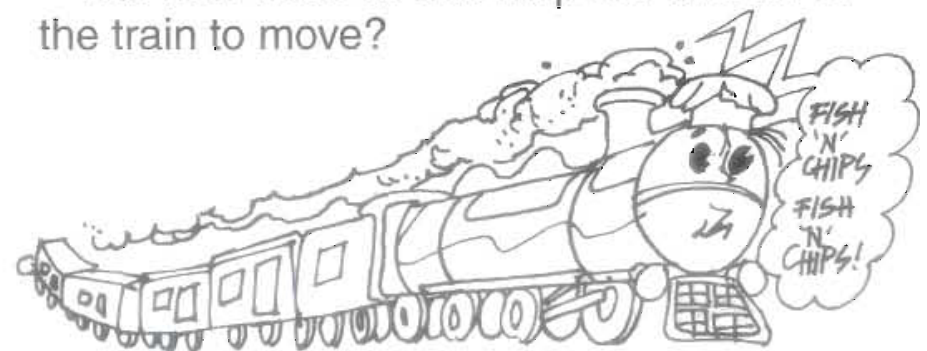
Steam is basically water converted into vapour by heat. It also has the capacity to expand. The engine is operated by the expansion of steam which, when admitted into a cylinder, moves a piston (a disc in the cylinder) to and fro. This to and fro motion is transmitted to the wheels of the train.

Let us try and understand this step by step. Steam is first created in a boiler. It is then sent through a pipe to a container known as the slide-valve chest, so-called because it admits steam from two openings by sliding to the left and right continuously.

When steam enters one side (say the left-hand side) of the slide-valve, it causes a

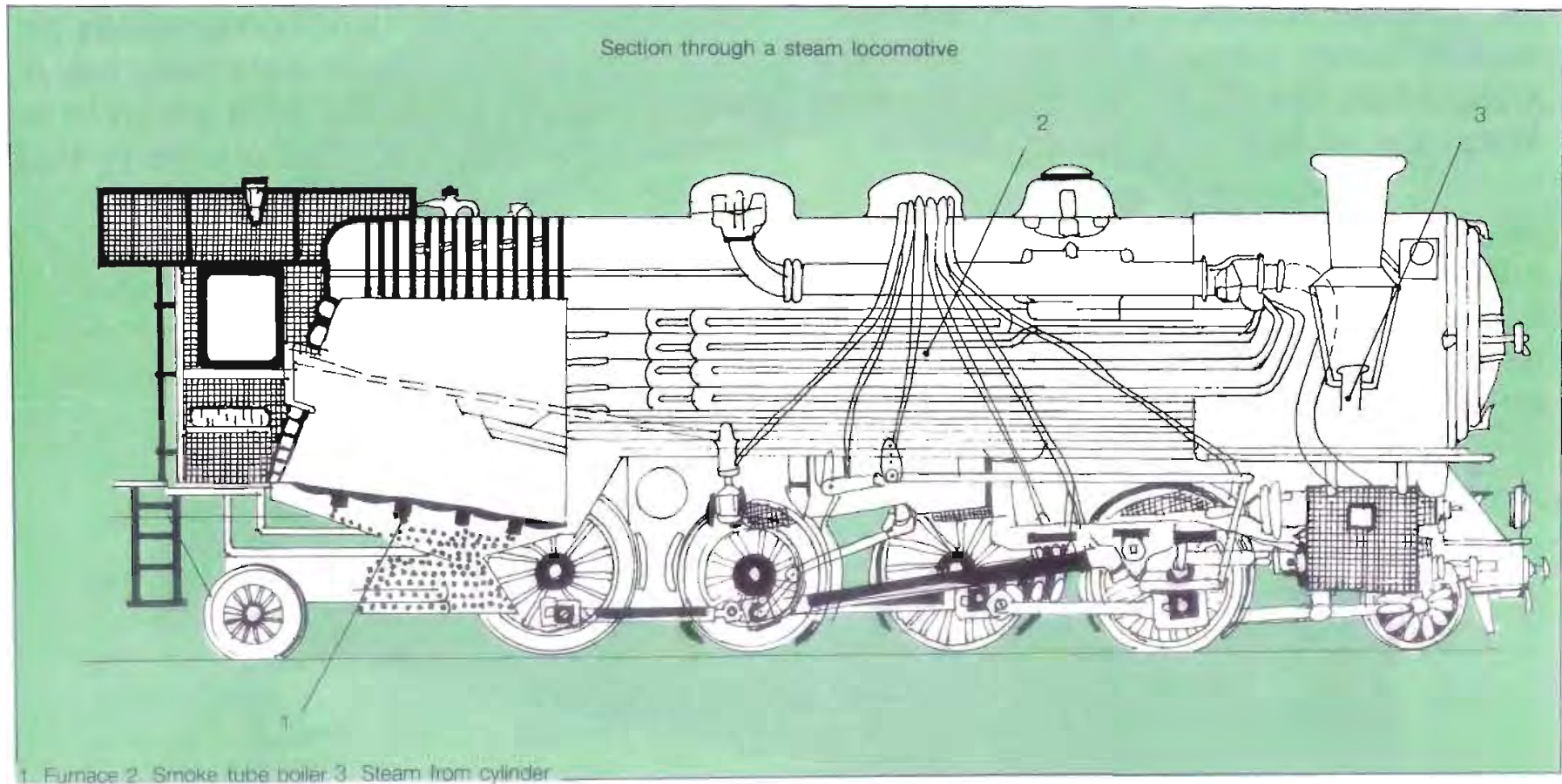
piston within it to move to the right. That is also the first sound the train makes—‘fishsh’! And once the piston moves to the right steam enters this side of the valve and causes the piston to move back to the left. That is the second sound—‘chips’! So the piston goes left and right or to and fro or ‘fish and chips’, and as the train gathers speed this movement gets faster and faster. As the steam expands, it also needs to get out of the valve. This is done through a chimney. Literally exhausted, the steam when it is pushed out seems to say ‘Soooooooooooooup’! (Next time you are in a train driven by steam engine, keep your ears cocked for these delicious sounds!)

But how does all this help the wheels of the train to move?



Connected to the piston which moves backwards and forwards is the driving rod, whose other end is connected to the driving

wheel. This does the work of a crankshaft in a car. It converts the to and fro motion of the piston into the rotary motion of the wheel.

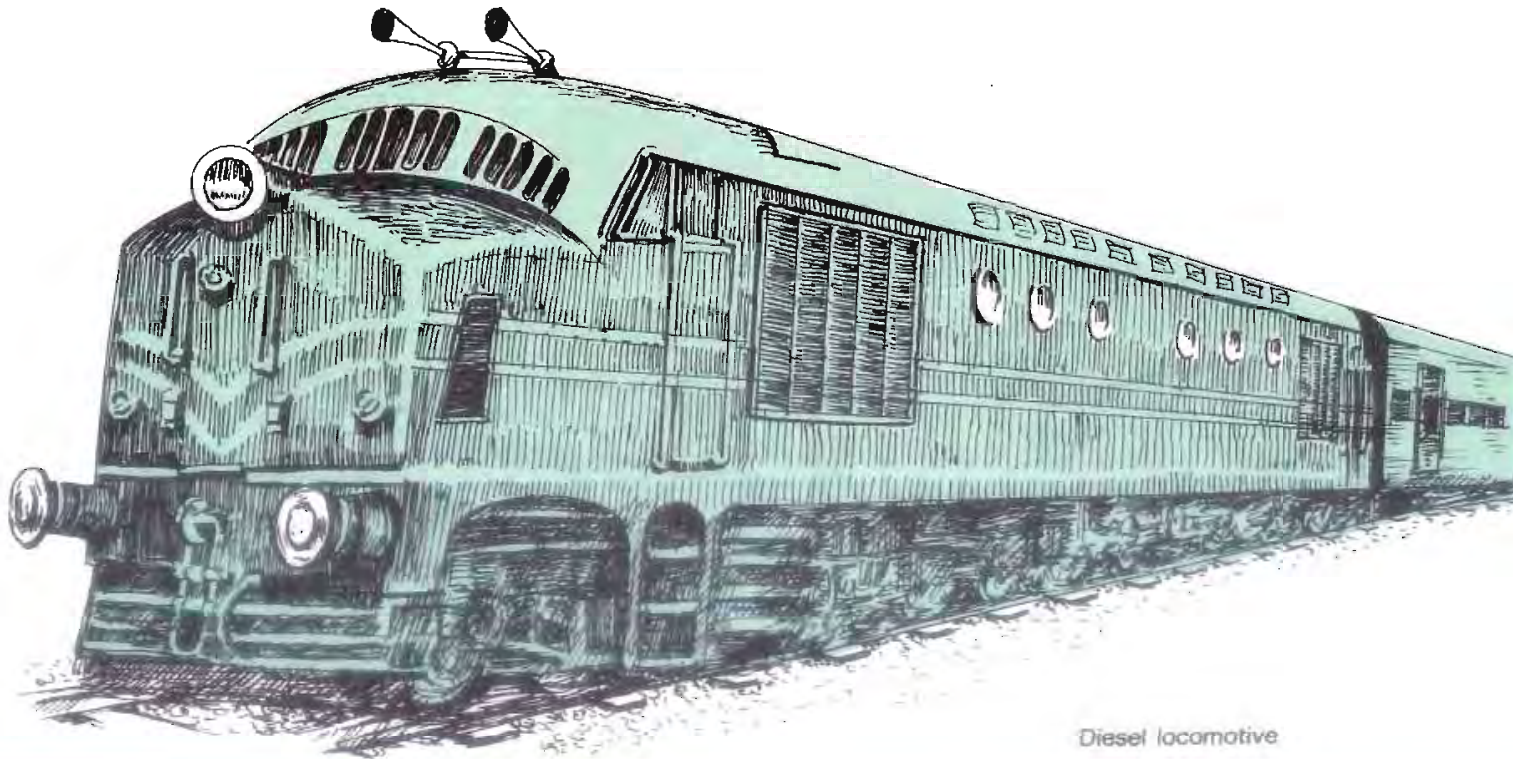


Diesel

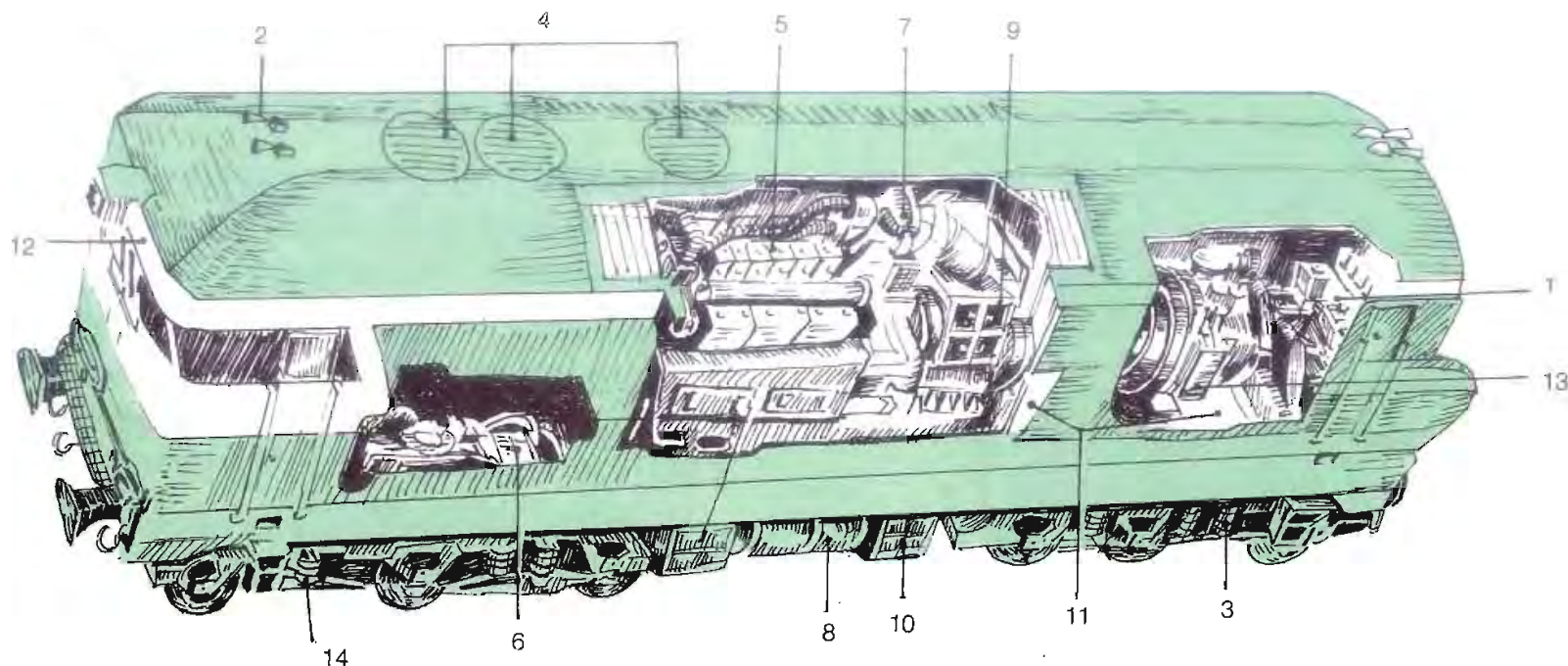
A few trains that run on our tracks are steam engines and use coal. Most of the trains, however, are of two other kinds. They run on diesel and electricity. They can be worked harder, faster and for longer periods, without interruptions like watering or coaling which are necessary for steam locos.

It was Rudolph Diesel who invented the kind of engine used today in millions of railway locomotives, trucks, buses, ships and cement mixers.

The diesel locomotive engine needs no sparking plug for ignition. It compresses air inside its cylinder to such a pressure that it becomes extremely hot. When a tiny squirt of fuel oil is pumped in, it ignites at once by itself.



Diesel locomotive

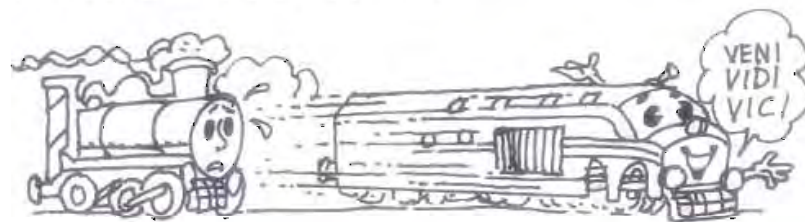


Inside of a diesel-electric locomotive

1. Driving cab 2. Warning horns 3. Three-axle bogie
 4. Radiators 5. Diesel engine 6. Traction motor 7. Turbo charger
 8. Oil fuel tank 9. Generator 10. Batteries 11. Walkways
 12. Driving cab 13. Train heating boiler 14. Three-axle bogie

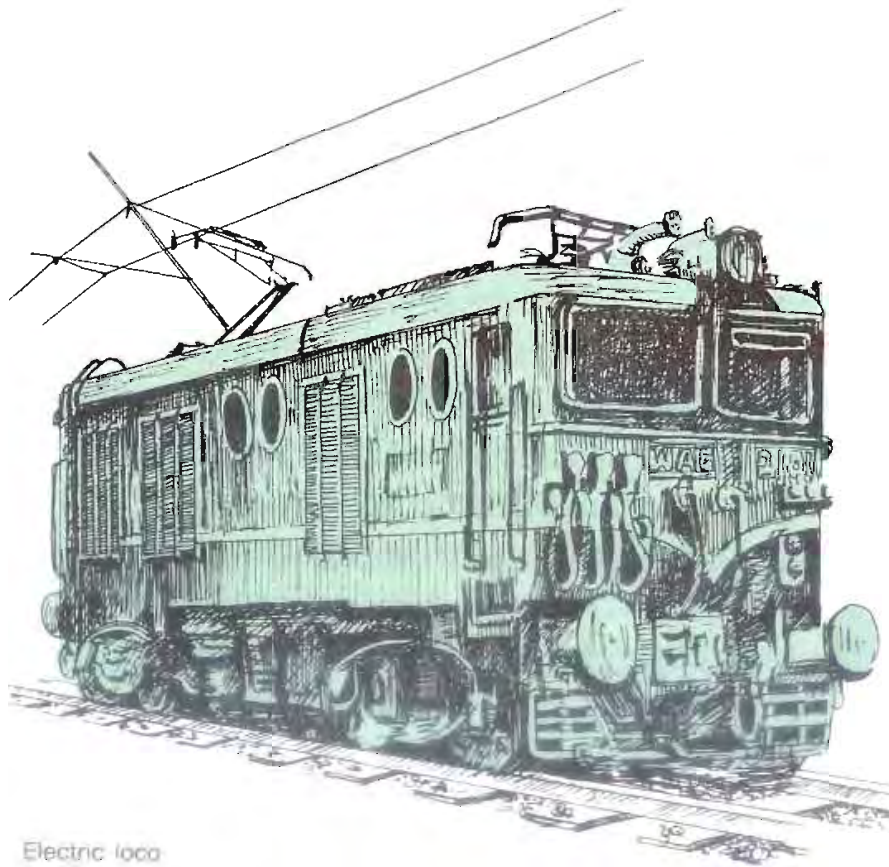
The diesel engine in a locomotive is connected to a dynamo (generator) which makes electric current. The current is led through wires and switches to electric motors to run the wheels.

The diesel engine is very efficient and does a lot of work for each litre of fuel it burns. It costs more to make than a steam engine but, because it is so much more efficient it costs less to run. That is why it has replaced most steam locomotives.



Electric trains

The electric locomotive is also commonly used today. One of its major advantages is that the power to drive the locomotive does



not have to be generated in the locomotive itself but can be supplied to it through overhead wires or through conductor rails. A further advantage is that the electric motor develops its highest torque (turning force applied to the wheels) at starting. This enables the locomotive, and the train it pulls, to move off more swiftly after stopping at a station.

Besides, the electric locomotive is quieter and produces no smoke or fumes. Even with the cost of generating electricity and installing power lines and other essential equipment, electric locomotive turns out to be much more efficient and economical than steam locomotive.

The principle of electric traction is to make electricity at a power-station and carry it to a locomotive. This is done by means of a pantograph that consists of metal wiper mounted on rods and pressed against the wire by springs.

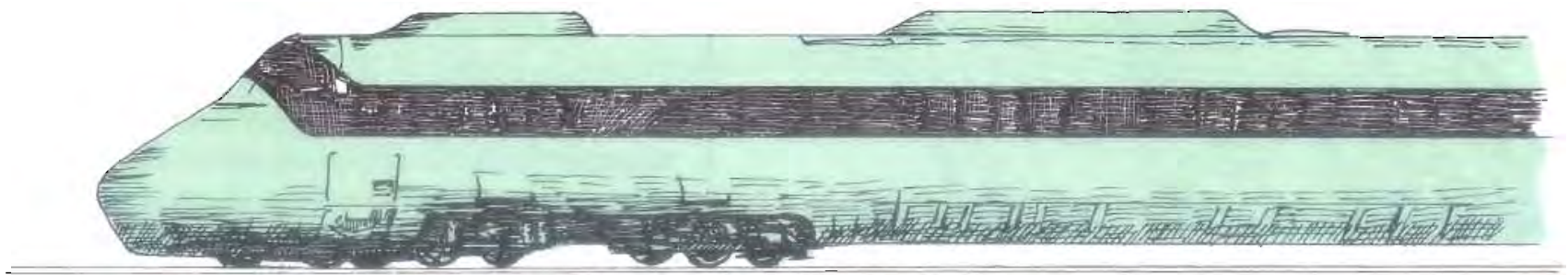
Advanced Passenger Trains

There are trains now which are driven by gas turbines, like smaller versions of the engines used in aeroplanes. These are known as Advanced Passenger Trains (APT) and are designed to run faster over ordinary track than any other train in the world. They have no separate locomotive. Instead, there are engines or electric motors at intervals

along the train. Some APTs are all-electric but, where the track is not electrified, the train is driven by gas turbines.

These trains are light and, by accelerating very fast, can keep up an extremely high average speed of more than 160 kilometres per hour.

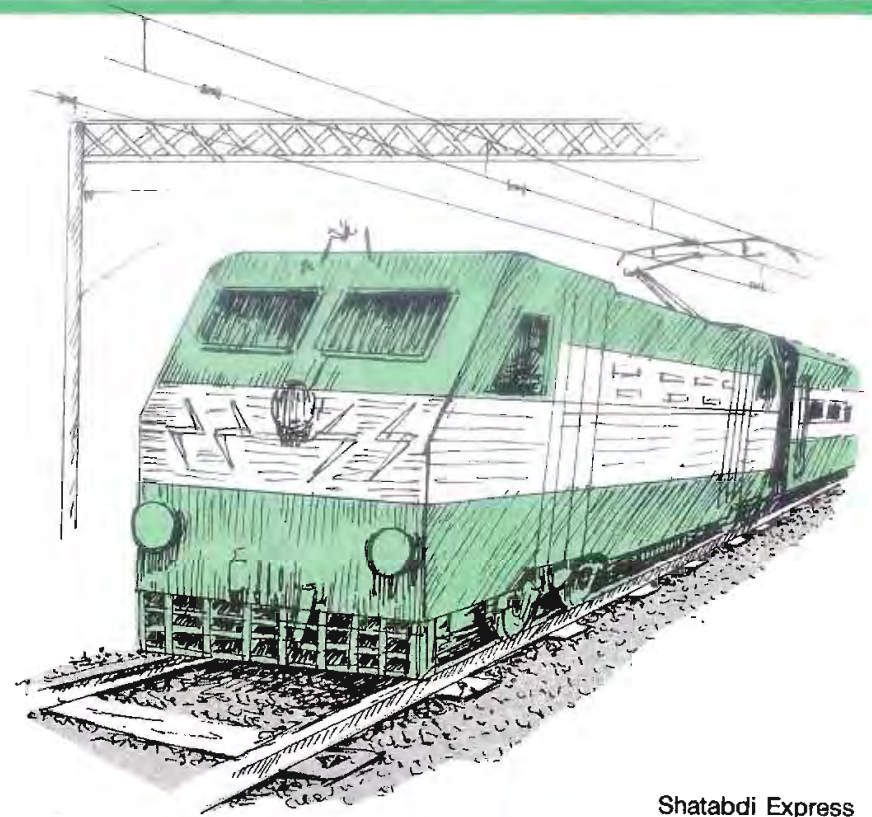
Diesel and electric trains have proved far more comfortable for the crew than steam-driven trains. Their engines are built like



Advanced Passenger Train (APT)

passenger coaches, with windows all round and are heated in winter and cooled in summer. The drivers are given handy controls and plenty of instruments so that they can see exactly how the engine and train are behaving.

Comfort and neatness took major priority when British Rail introduced the High-Speed Train (HST) in 1972. The driver has all the controls at his fingertips, and if anything were to go wrong he would be instantly informed by an illuminated warning display. Eventually drivers will be in constant communication with other trains and with railway controllers by means of electronic control systems.



Shatabdi Express

The fastest train in India is the Shatabdi Express, travelling at 140 kilometres per hour; it was introduced in 1988. It can get you from Delhi to Jhansi in four hours and forty minutes. Thirteen such trains are in operation now connecting, among others, Mumbai to Ahmedabad, Ajmer to New Delhi, Mysore to Chennai and Rourkela to Howrah.

'Pullman'

Today, with attempts being made to further improve the performance of railway engines, it is difficult to imagine a time when there were no trains. We are so used to them that we tend to take them for granted. In fact we even look down upon them at times as being less glamorous.

The definition of glamour, however, continues to change. Years ago when George Pullman designed some luxurious trains he became famous for planning the ultimate in travel hospitality. In the dictionaries

One of the most ornate royal saloons was that run by the Bavarian Railways for 'Mad Ludwig' (King Edward II). It was done in royal blue with gilding inside and out. Next to the royal coach was the Balcony carriage where the monarch received guests wherever the train stopped.



Luxury in running train

of twenty languages throughout the world 'Pullman' appears as a noun connoting luxury, comfort and safety in overland transportation.

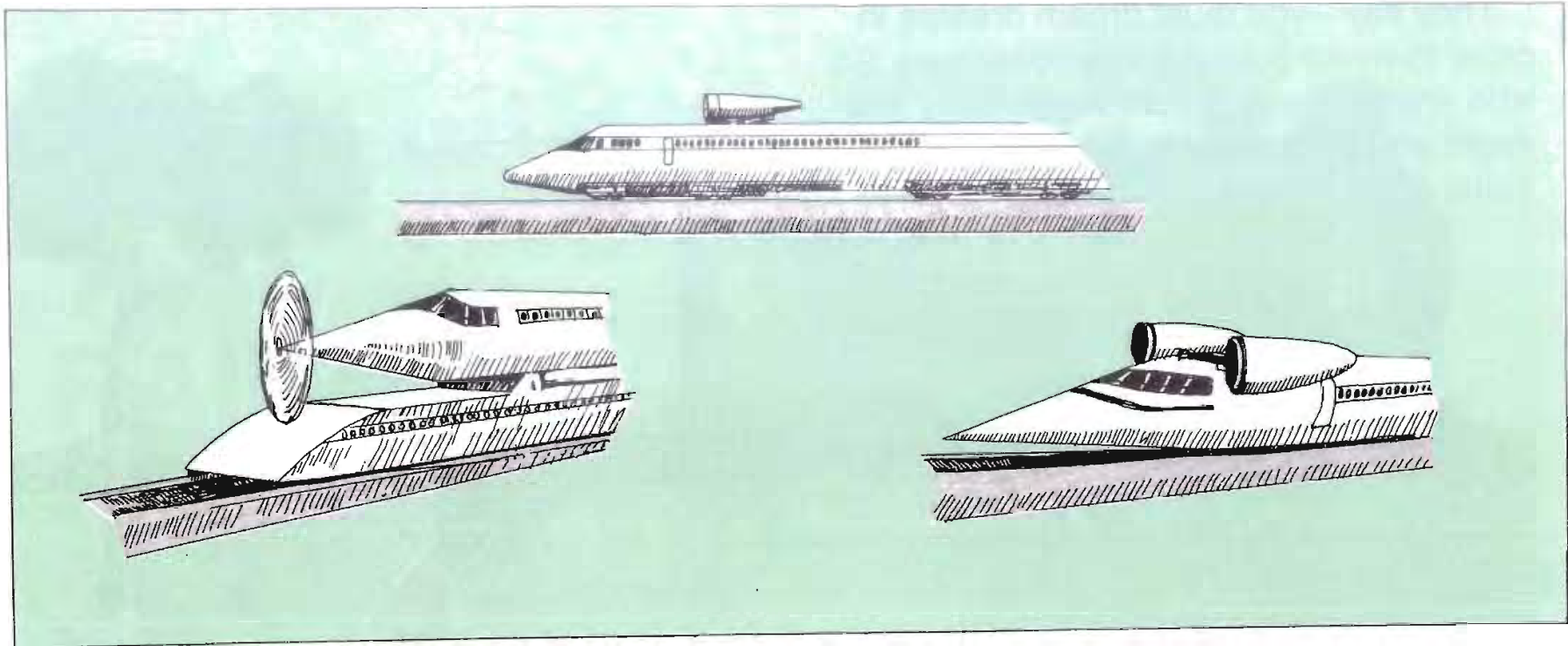
In India, the first luxury train called 'Palace on Wheels', was started in January 1982 by

the Rajasthan Tourism. The Palace was driven by a steam engine and consisted exclusively of saloons and state carriages of former Maharajas. Each saloon had all the facilities of a small house and a five-star service on board.



Palace on Wheels



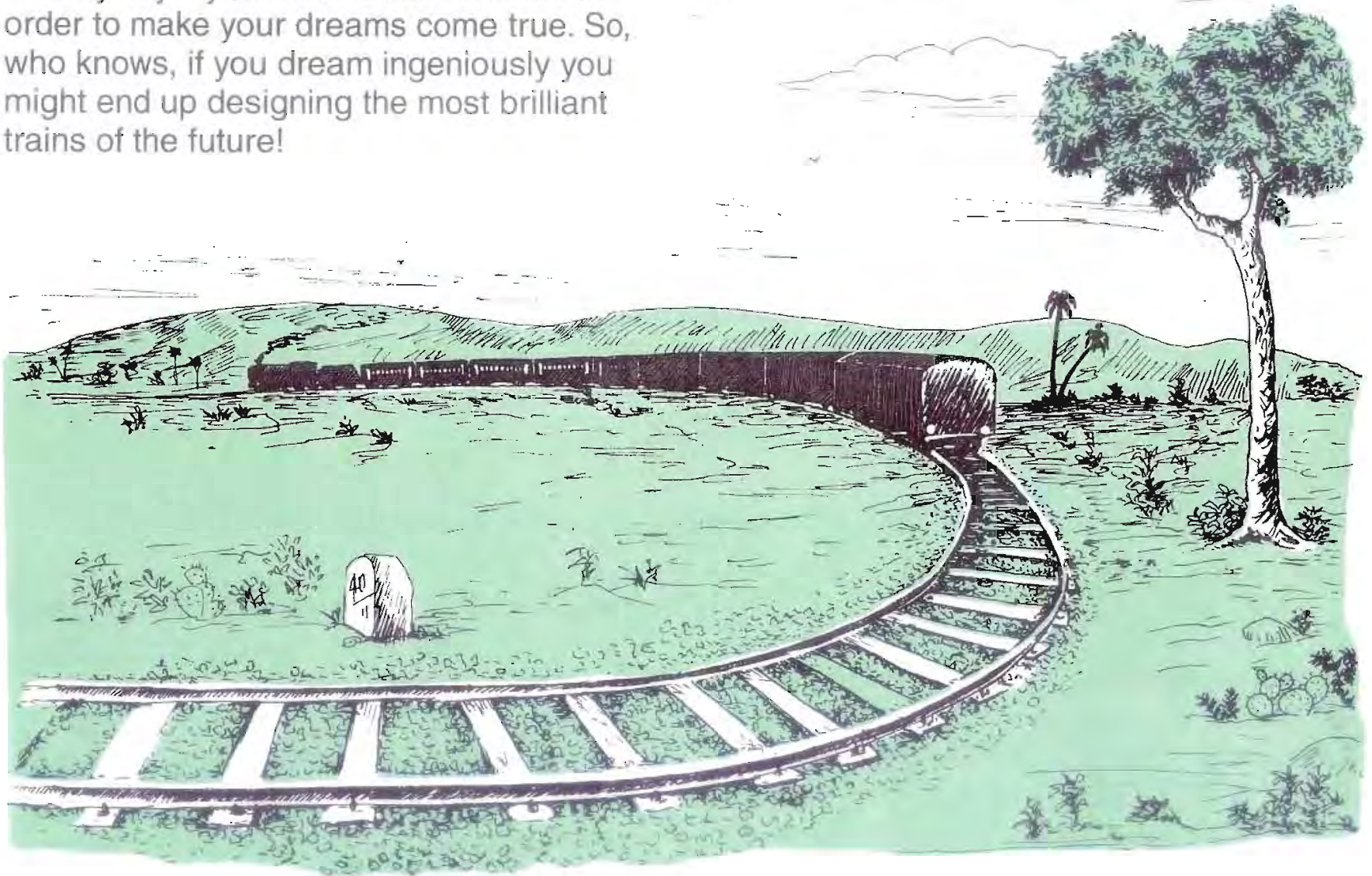


Futuristic trains

With the onset of the jet-age, glamour in transport has come to be associated with speed. No wonder then, it is being said that trains will soon be gathering speed by plunging to the earth's core before gradually returning to the surface, perhaps on another

continent! Or, a vacuum might be created in front of the vehicle so that the atmospheric pressure would drive it along a tube, like a piston in a cylinder! Another possibility would be to pump air from the front of the vehicle and expel it from behind. For the present, of course, these are dreams.

They say—you must dream dreams in order to make your dreams come true. So, who knows, if you dream ingeniously you might end up designing the most brilliant trains of the future!



This book, one of a series of information books, introduces the child to the train. It explains how the train works and traces briefly the history and development of the train, particularly the Indian Railways.

Others in this series include:

- The Television
- The Telephone
- The Motor Car
- The Aeroplane
- The Ship
- The Clock
- The Computer

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